High Production Volume (HPV) Challenge Program

Test Plan and Robust Summaries

For

Alkyl (C_{12}-C_{14}) Glycidyl Ether

Submitted to the US Environmental Protection Agency

by

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1.0 INTRODUCTION

Alkyl glycidyl ethers (AGEs) are epoxy resin additives derived from glycidol and are used as modifiers for other epoxides in flooring and adhesives. The TSCA Section 4 Interagency Testing Committee (ITC) designated the category glycidol and its derivatives (termed 'glycidyls') for priority consideration for health effects testing. The chemical category, glycidyls, was defined by the Environmental Protection Agency's (EPA) ITC as all substances with the general formula:

$R\text{-}O\text{-}CH_2CH(O)CH_2$

where R is a hydrogen atom or any alkyl, aryl, or acyl group, and R is unrestricted as to the number and type of substituents it may carry.

The Epoxy Resin Systems Task Group (ERSTG) has committed to provide basic chemistry, environmental fate, ecotoxicity and human health effects information on alkyl (C_{12}-C_{14}) glycidyl ether (CAS 68609-97-2) listed under the EPA High Production Volume (HPV) Chemical Challenge Program. By participating in this voluntary program, the ERSTG has agreed to assess the adequacy of existing data; prepare summaries of the data characterizing the chemical; determine data needed to fulfill the HPV data requirements; and design and submit a test plan to satisfy these testing requirements.

The HPV Challenge Program endorses the development of chemical categories and the use of surrogate data from a structurally similar chemical(s) as an acceptable mechanism to achieve an efficient completion of the program goals. EPA considers this an acceptable premise for chemicals whose physicochemical and toxicological properties are likely to be similar, or follow a regular pattern as a result of structural similarity. In this context, EPA and certain alkyl glycidyl ether manufacturers negotiated an Enforceable Consent Agreement (ECA) (Docket: OPPTS-42185, FR, March 22, 1996) wherein these companies agreed to perform certain health effects tests using alkyl (C_{12}-C_{13}) glycidyl ether (CAS # 120547-52-6) as a representative of the alkyl glycidyl ether subcategory of EPA's test rule for glycidol and its derivatives. This includes the HPV chemical alkyl (C_{12}-C_{14}) glycidyl ether. Many of these health effects tests have been completed, submitted to EPA, and are reviewed herein under Health Effects Data. In light of this agreement, and structural similarities, the ERSTG believes alkyl (C_{12}-C_{13}) glycidyl ether is an acceptable surrogate source of data in support of alkyl (C_{12}-C_{14}) glycidyl ether under the HPV Challenge Program.

2.0 EVALUATION OF DATA

When and where data are lacking for the HPV chemical, alkyl (C_{12}-C_{14}) glycidyl ether, use of data from the surrogate chemical, alkyl (C_{12}-C_{13}) glycidyl ether is not only scientifically justified, but also encouraged. This position is bolstered by: (1) EPA's guidance on this particular category (i.e. glycidyls) noted above under 1.0; and (2) its position presented before the OECD Working Party on Existing Chemicals (1999) that industry should minimize, as well as optimize, animal usage when fulfilling HPV data

requirements. Therefore, data for both CAS # 120547-52-6 and 68609-97-2 have been considered equally with regards to HPV data requirements for CAS #68609-97-2, using scientifically reliable data. A table showing the available studies for the HPV endpoints is located on page 7.

2.1 Physical Chemical Description of Alkyl (C_{12}-C_{14}) Glycidyl Ether

2.1.1 Melting Point: 35°F [Ref 9]

2.1.2 Boiling Point: 420°F [Ref 10]

2.1.3 Vapor Pressure: 0.06 mmHg @ 70°F [Ref 11]

2.1.4 Partition Coefficient: log Kow = 7.25 [Ref 12]; no measured data available

2.1.5 Water Solubility: 0.02197 mg/L [Ref 13]; no measured data available

2.1.6 Summary of Physical/Chemical Data

Reference data are available for all alkyl (C_{12}–C_{14}) glycidyl ether physical chemical endpoints except the water solubility and partition coefficient. Testing is proposed to determine the water solubility and partition coefficient of alkyl (C_{12}–C_{14}) glycidyl ether.

2.2 Environmental Fate and Pathways Data

2.2.1 Biodegradation

No data available; testing is proposed to determine biodegradation.

2.2.2 Photodegradation

Estimation Programs Interface for Microsoft® Windows (EPIWIN V3.05, U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics, Washington, D.C.), Atmospheric Oxidation Program (v1.90) modeling component was used to calculate the rate of photodegradation for alkyl (C_{12}–C_{14}) glycidyl ether. The half-life was calculated to be 0.331 days (or 3.97 hours), assuming the reaction occurred over a 12-hour day with an average atmospheric concentration of 1.5E6 OH/cm^3. [Ref. (14)]

2.2.3 Hydrolysis (Stability in Water)

No data available; testing is proposed to determine stability in water.

2.2.4 Transport/Distribution

The LEV3EPI fugacity model (from EPIWIN V3.05, USEPA) was used for predicting partitioning of alkyl (C_{12}–C_{14}) glycidyl ether among air, water, soil and sediment compartments. The following are the concentration results using a soil K_{oc} of 7.29e+006 as calculated by the model and a log K_{ow} of 7.25 as calculated by the KOWWIN (USEPA) program [Ref. (15)]:

- Air 0.6%
- Water 7.7%
- Soil 28.8%
- Sediment 62.9%

2.2.5 Summary of Environmental Fate and Pathways Data

The photodegradation and fugacity of alkyl (C_{12}–C_{14}) glycidyl ether were assessed through computer modeling. Biodegradability and hydrolysis data are not available for alkyl (C_{12}–C_{14}) glycidyl ether. Testing is proposed to determine the biodegradability of alkyl (C_{12}–C_{14}) glycidyl ether and its stability in water.

2.3 Ecotoxicology Data

No Ecotoxicology data is available for alkyl (C_{12}–C_{14}) glycidyl ether. The following ecotoxicology testing is therefore proposed: acute toxicity to fish, acute toxicity to aquatic invertebrates and toxicity to aquatic plants.

2.4 Health Effects Data

2.4.1 Acute Health Effects

2.4.1.1 Acute Dermal Toxicity

Sexually mature male New Zealand albino rabbits were exposed dermally to doses of alkyl (C_{12}-C_{14}) glycidyl ether, ranging from 0.5 to 4.5 ml/kg (equivalent to 4 g/kg). The test material was applied undiluted. There was no mortality. Only slight irritation was observed at 24 hours, and moderate irritation was reported after 72 hours in all treated groups. Immediately prior to sacrifice, blood was collected from the vena cava of each animal and checked for Hgb, Hct, WBC, RBC, and differential leukocyte counts. Organ weights were determined for testes with and without epididymis, and for liver, heart, kidneys and brain. The testes, epididymis, ductus deferens, seminal vesicles, prostate and heart were further subjected to histopathological examination. There were no compound-related effects on body weight, organ weights, and blood morphology, and no adverse effects observed at gross necropsy or histopathological examinations. [Ref. (8)]

2.4.1.2 Summary of Acute Toxicological Effects

Alkyl (C_{12}-C_{14}) glycidyl ether demonstrated a dermal LD50 of >4 g/kg body weight, causing only slight to moderate irritation after 3 days. Further examination of selected organs and blood parameters failed to illustrate any adverse effects on the blood parameters measured or tissues examined. Special attention was given to the male reproductive organs, as well as liver and kidneys. This dermal toxicity test satisfies the HPV requirement for acute health effects data. No further acute toxicity testing is proposed.

2.4.2 Genetic Toxicology

2.4.2.1 Bacterial Gene Mutation Assay

Alkyl (C_{12}-C_{13}) glycidyl ether was examined in a contemporary bacterial reverse mutation assay using Salmonella typhimurium strains TA98, TA100, TA1535, TA1537 and Escherichia coli strain WP2 uvrA in the presence or absence of Aroclor 1254-induced rat liver S9. Alkyl (C_{12}-C_{13}) glycidyl ether was mutagenic in Salmonella typhimurium TA1535 with and without S9 activation. [Ref. (4)]

2.4.2.2 In Vitro Mammalian Cell Gene Mutation Assay

Alkyl (C_{12}-C_{13}) glycidyl ether was tested in the Chinese hamster ovary (CHO) cells, subline CHO-K_1-BH_4, in the presence and absence of Aroclor 1254-induced rat liver S9. In a preliminary cytotoxicity assay, alkyl (C_{12}-C_{13}) glycidyl ether produced a visible precipitate at 500 µg/ml and above, when tested at doses of 0.5 to 5000 µg/ml with and without activation. Cloning efficiency was 18% at 5000 µg/ml without activation, and 4% at 150 µg/ml with metabolic activation. Based upon the toxicity test results the doses selected ranged from 100-5000 µg/ml without activation, and 25-150 µg/ml with S9 activation. The minimum mutation frequency was set at >40 mutants per 10^6 clonable cells. Alkyl (C_{12}-C_{13}) glycidyl ether did not induce mutations at the HGPRT locus in Chinese hamster ovary cells. [Ref. (6)]

2.4.2.3 In Vivo Chromosomal Aberration Assay

Alkyl (C_{12}-C_{13}) glycidyl ether was examined for chromosomal aberration effects in a micronucleus cytogenetic assay using ICR mice. The test material was given via intraperitoneal injection at doses up to 4000 mg/kg determined from a preliminary pilot toxicity assay. The number of micronucleated polychromatic erythrocytes (PCEs) per 1000 erythrocyte cells in the test groups was not statistically increased relative to the vehicle control in either sex. Alkyl (C_{12}-C_{13}) glycidyl ether was not clastogenic in the micronucleus test using male and female ICR mice. [Ref. (5)]

2.4.2.4 Summary of Genetic Toxicology Effects

Alkyl (C_{12}-C_{13}) glycidyl ether was examined for gene mutations in in vitro bacteria and mammalian cell assays. Alkyl (C_{12}-C_{13}) glycidyl ether was positive for basepair substitutions in Salmonella typhimurium strain TA1535 in the bacterial reverse mutation assay. However, it was negative in all other Salmonella typhimurium strains tested (TA98, TA100 and TA1537), as well as E. coli strain WP2 uvrA. E. coli WP2 uvrA and Salmonella typhimurium TA 100, which also test for basepair substitutions, were negative. In an in vitro cytogenetic assay in mammalian cells in culture (CHO- K_1-BH_4), alkyl (C_{12}-C_{13}) glycidyl ether was negative.

Alkyl (C_{12}-C_{13}) glycidyl ether was not clastogenic when examined for in vivo chromosomal aberrations in the micronucleus assay using ICR mice. Alkyl (C_{12}-C_{13}) glycidyl ether was not genotoxic in mammalian assays that measured gene mutations and chromosomal aberrations. The results of these genetic toxicity assays satisfy the HPV requirements for genetic toxicity data and no further genetic toxicity testing is recommended.

2.4.3 Repeated Dose Health Effects

2.4.3.1 Subchronic Dermal Toxicity

Alkyl (C_{12}-C_{13}) glycidyl ether was administered dermally once a day, 5 days/week for 14 days to male and female Fischer 344 rats in 2-week range-finding study. Doses ranged from 10-1000 mg/kg/day. Doses of 1000 mg/kg exceeded the maximum tolerated dose. Epidermal hyperplasia of the sebaceous glands was present at 100 and 1000 mg/kg. Dermal changes at 10 mg/kg were limited to slight scaling. [Ref. (1)]

In a 13-week repeated dose dermal toxicity study, Fischer 344 rats were exposed to doses of alkyl (C_{12}-C_{13}) glycidyl ether once/day, 5 days/week for 13 weeks. A total of 66 daily doses were administered, ranging from 1 to 100 mg/kg. Test material was not occluded or wiped off between doses. Animals were housed one per cage; it was not stated whether collars were used. Cageside observations conducted daily were unremarkable. Food consumption and body weight gain were not affected. There were no compound-related effects on hematological, clinical chemistry, or urinalysis parameters measured. There was also no effect on organ weights for adrenal glands, liver, kidneys, brain, ovaries and testes. A full compliment of tissues were fixed and examined grossly, including all reproductive organs in control and high-dose groups. No adverse effects were observed except for thickened and scaly skin in high-dose rats at the site of application. Histopathological evaluation of tissues revealed only effects to the dermis in high-dose rats, with hyperkeratosis and hyperplasia of the epidermis, hyperplasia of sebaceous glands and inflammation. A No Observable Adverse Effect Level (NOAEL) was demonstrated at 1 mg/kg, based upon effects on the skin at 10 and 100 mg/kg. [Ref. (2)]

A 13-week neurotoxicity study was performed using Fischer 344 rats. They were exposed to repeated dermal doses (1 to 100 mg/kg) of alkyl (C_{12}-C_{13}) glycidyl ether once/day, 5days/week for 14 weeks. Test material was not occluded or wiped off between doses. Cageside observations conducted daily were unremarkable. Body weight gain was not affected. Dermal effects were confined to the mid- and high- dose groups, with well-defined erythema, edema, and moderate to severe scabbing. Effects were more severe in the high-dose rats, compared to mid-dose animals. No compound-related effects were seen in control or low-dose animals. Functional Observational Battery (FOB) and Motor Activity (MA) analyses were conducted pre-exposure and at the end of each month of exposure. There were also Electrodiagnostic Tests or Evoked Potential Battery conducted within a few days of the last exposure, plus a comprehensive neuropathological examination of perfused tissues. Histological examination was confined to neuropathology of the CNS and PNS in high-dose and control groups only. There were no effects observed for FOB, MA or for neuropathology. Electroretinograms (ERGs) were performed to identify effects on the retina. These were followed by histopathological examination of the retinas to confirm structural changes. No adverse effects were observed or confirmed, and it was concluded that a NOAEL of 1 mg/kg was demonstrated, based upon effects on the skin at 10 and 100 mg/kg, and mild Flash Evoked Potential (FEP) alterations in male rats at 10 and 100 mg/kg. [Ref. (3)]

Based upon the data generated from these contemporary repeated dose studies, conducted under Good Laboratory Practice (GLP) regulations, and in recognition of the testing requirements in the ECA, no additional repeated dose studies are proposed.

2.4.4 Reproductive Toxicity

Effects on the reproductive organs were assessed in several separate toxicity studies summarized above. The male reproductive organs were examined histologically in the acute dermal LD50 study (2.4.1.1) using alkyl (C_{12}-C_{14}) glycidyl ether and no effects observed at doses up to 4 g/kg. Gross necropsy of male and female Fischer 344 rats

exposed for 2 weeks to dermal doses of alkyl (C_{12}-C_{13}) glycidyl ether of up to 100 mg/kg revealed no adverse effects. In a 13-week dermal study, also in Fischer 344 rats, gross and histopathologic examinations revealed no adverse effects on the ovaries and testes of animals dosed with alkyl (C_{12}-C_{13}) glycidyl ether at 100 mg/kg. In a separate 13-week neurotoxicity study using alkyl (C_{12}-C_{13}) glycidyl ether, which included FOB and EP tests, there were no adverse effects on the reproductive organs in male and female rats examined grossly at doses up to and including 100 mg/kg. [Ref. (2) and (3)]

Based upon these findings and the results from a developmental toxicity study, no further testing for reproductive effects is recommended. This conclusion is supported by guidance presented in EPA's guidance document for meeting HPV testing requirements wherein it is recommended that when a scientifically reliable 90-day repeated dose study also examines the reproductive organs, a separate reproductive toxicity study is not necessary. Further, when effects on reproductive organs are examined in a 90-day study and where there is also an adequate developmental study, the HPV requirement for a reproductive study is satisfied.

2.4.5 Developmental Toxicity

Virgin female Sprague-Dawley rats were mated with resident male rats of the same strain, and, after confirmation of pregnancy, were given alkyl (C_{12}-C_{13}) glycidyl ether dermally, 6 hours per day from gestation day 6 thru 15. There were 5 dose levels administered, ranging from 1 to 200 mg/kg. Dermal sites were not occluded and test material was removed by washing after each 6-hour exposure period. Females were sacrificed on day 20 of gestation. There were no significant cageside observations, no effect on body weight gain or food consumption and no adverse autopsy findings. The only adverse effect observed was dermal irritation at 50 mg/kg and greater. Fissuring, eschar formation, and atonia occurred at 100 and 200 mg/kg. The NOAEL for dermal irritation was 10 mg/kg. There were no compound related effects on fertility, intrauterine growth, survival, the number of CL, implantation sites, early or late resorptions, or on the number of dead fetuses. Mean fetal crown-rump length, mean placenta weight, and mean fetal body weight were similar in all groups. There were no external malformations or developmental variations observed and a NOAEL of 200 mg/kg was determined in this study for maternal and developmental toxicity. [Ref. (7)]

The study was conducted in accordance with a recognized scientific procedure and screening bioassay for examining compound related effects on the developing fetus and in compliance with GLP regulations. No further developmental testing is proposed.

2.4.6 Summary of Repeated Dose, Reproductive and Developmental Toxicity Effects

All of the repeated dose and developmental toxicity studies were performed using alkyl (C_{12}-C_{13}) glycidyl ether, as agreed in the ECA. All studies are considered scientifically reliable and support the findings with respect to NOAELs and compound related effects observed. Repeated dermal contact for 2 weeks or 13 weeks resulted in a NOAEL of 1 mg/kg/day.

Potential neurological effects were evaluated in rats following repeated dermal exposures for 14 weeks. A NOAEL of 1 mg/kg was demonstrated, based upon effects on the skin at 10 and 100 mg/kg, and mild Flash Evoked Potential (FEP) alterations in male rats at 10 and 100 mg/kg.

Effects on the reproductive organs were assessed in all of the repeated dose studies summarized above. There were no adverse effects on the reproductive organs in males and females examined grossly or histologically at doses up to and including 100 mg/kg.

In a separate dermal developmental screening study, there were no compound related effects and a NOAEL of 200 mg/kg was determined for maternal and developmental toxicity.

All of these studies are scientifically reliable, comply with GLP regulations and were conducted according to international standards for such studies. No further repeated dose, reproductive or developmental toxicity testing is proposed.

3.0 CONCLUSIONS

The following table identifies the data available and the data gaps which exist for alkyl (C_{12}-C_{14}) glycidyl ether. Partition coefficient data will be generated, as will stability in water and biodegradation. Also, the following ecotoxicity tests will be conducted, as appropriate: acute toxicity to fish, acute toxicity to aquatic invertebrates, and toxicity to aquatic plants.

Based upon the examination of available health effects data it is proposed that no further health effects studies or data are needed. All health effects studies fulfilling HPV data requirements are scientifically reliable, comply with GLP regulations and were conducted according to international standards for such studies.

TABLE 1: HPV DATA REQUIREMENTS/CRITICAL STUDIES: Alkyl (C_{12}-C_{14}) Glycidyl Ether

HPV Data Category	Test Endpoint		Data Acceptable	Data to be Generated
Physical and Chemical Properties	Melting Point		Yes	No
	Boiling Point		Yes	No
	Vapor Pressure		Yes	No
	Partition Coefficient		No	Yes
	Water Solubility		No	Yes
Environmental Fate and Pathways	Photodegradation		Yes	No
	Stability in Water		ND	Yes
	Biodegradation		ND	Yes
	Transport/Distribution		Yes	No
Ecotoxicity	Acute toxicity to Fish		ND	Yes
	Acute toxicity to Aquatic Invertebrates		ND	Yes
	Toxicity to Aquatic Plants		ND	Yes
	Chronic aquatic invertebrate test[1]		NR	No
	Terrestrial toxicity[1]		NR	No
Health Effects	Acute toxicity		AD-1 (2)	No
	Repeated Dose		SC-4, -5 and –6 (1) SU	No
	Genetic Toxicity	Gene Mutation	MU-17 and –19 (1) SU	No
		Chromosome Aberration	MU-18 (1) SU	No
	Reproductive Toxicity		SC-5 and –6 (1) SU	No
	Developmental Toxicity		DE-1 (2) SU	No

1 = Test are not required for all chemicals; only when appropriate.
NR = Not required
ND = No Data
SU = Surrogate Data (EPA Enforceable Consent Agreement; C12-C13)

Data listed are cross-referenced to a Robust Summary Report number (i.e. AD-1 (2)); which identifies the report number and Klimisch Rating in ( ). Only studies with the following Klimisch Ratings are included: (1) = reliable without restriction and (2) = reliable with restriction. If this is followed by SU it means the critical study (s) was (were) derived from surrogate data (i.e. C_{12}-C_{13}). If more than one study is listed it means they are co-critical.

LIST OF REFERENCES

120547-52-6 (C_{12}-C_{13})

Ref.(1). SC-4 (C_{13}): Repeated Dose
The Society of the Plastics Industry, Epoxy Resin Systems C_{12}-C_{14} Task Force. Alkyl Glycidyl Ether: 2-Week Range Finding and 13-Week Repeated Dose Dermal Toxicity Study in Fischer 344 Rats. Testing Facility: Toxicology Research Laboratory, Health & Environmental Research Laboratories, Dow Chemical USA, Midland MI; Study #960026; Study dated August 1997.
Klimisch = 1

Ref.(2). SC-5 (C_{13}): Repeated Dose and Reproduction
The Society of the Plastics Industry, Epoxy Resin Systems C_{12}-C_{14} Task Force. Alkyl Glycidyl Ether: 2-Week Range Finding and 13-Week Repeated Dose Dermal Toxicity Study in Fischer 344 Rats. Testing Facility: Toxicology Research Laboratory, Health & Environmental Research Laboratories, Dow Chemical USA, Midland MI; Study #960026; Study dated August 1997.
Klimisch = 1

Ref.(3). SC-6 (C_{13}): Repeated Dose and Reproduction
The Society of the Plastics Industry, Epoxy Resin Systems C_{12}-C_{14} Task Force. Alkyl Glycidyl Ether: 13-Week Neurotoxicity Study in Fischer 344 Rats. Testing Facility: Toxicology Research Laboratory, Health & Environmental Research Laboratories, Dow Chemical USA, Midland MI; Study #971000 PTR#50068-240-1; Study dated November 1997.
Klimisch = 1

Ref.(4). MU-17 (C_{13}): In Vitro (Gene Mutation: Bacteria)
The Society of the Plastics Industry, Epoxy Resin Systems C_{12}-C_{14} Task Force. Bacterial Reverse Mutation Assay with an Independent Repeat Assay. Testing Facility: MA BioServices, Inc., 9630 Medical Center Drive, Rockville, MD 20850; Study # G96BK39.502001R; Project 805-13-2; Study dated November 1997.
Klimisch = 1

Ref.(5). MU-18 (C_{13}): In Vivo (Chromosomal Aberration)
The Society of the Plastics Industry, Epoxy Resin Systems C_{12}-C_{14} Task Force. Micronucleus Cytogenetic Assay in Mice. Testing Facility: Microbiological Associates, Inc. (MA), 9630 Medical Center Drive, Rockville, MD 20850; Study #G96BK39.122; Project 805-13-3; Study dated February 1997.
Klimisch = 1

Ref.(6). MU-19 (C_{13}): In Vitro (Gene Mutation: Mammalian Cell)
The Society of the Plastics Industry, Epoxy Resin Systems C_{12}-C_{14} Task Force. In Vitro Mammalian Cell Gene Mutation Test with an Independent Repeat Assay. Testing Facility: MA BioServices, Inc., 9630 Medical Center Drive, Rockville, MD 20850; Study # G96BK39.782001R; Project 805-13-2; Study dated March 1998.
Klimisch = 1

Ref.(7). DE-1 (C_{13}): Developmental
The Society of the Plastics Industry, Epoxy Resin Systems C_{12}-C_{14} Task Force. A Dermal Developmental Toxicity Screening Study of Alkyl Glycidyl Ether in Rats. Testing Facility: WIL Research Laboratories, Ashland, OH 44805-9281; Study #WIL-284001; Study dated August 1996.
Klimisch = 2

68609-97-2 (C_{12}-C_{14})

Ref.(8). AD-1 (E): Acute Dermal
The Proctor and Gamble Company. Multi-Dose Acute Percutaneous Toxicity - Rabbits. Testing Facility: Springborn Institute for Bioresearch, Inc. Spencerville, OH 45887; Study #3029.526; Study dated April 1980.
Klimisch = 2

Ref.(9). Melting Point
Powell, C. H. (ed). *Patty's Toxicology*. John Wiley & Sons, Inc., 2001.
Klimisch = 2

Ref.(10). Boiling Point
Powell, C. H. (ed). *Patty's Toxicology*. John Wiley & Sons, Inc., 2001.
Klimisch = 2

Ref.(11). Vapor Pressure
Powell, C. H. (ed). *Patty's Toxicology*. John Wiley & Sons, Inc., 2001.
Klimisch = 2

Ref.(12). Partition Coefficient
Estimation Programs Interface for Microsoft® Windows (EPIWIN V3.05, U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics, Washington, D.C.)
Klimisch = 2

Ref.(13). Water Solubility
Estimation Programs Interface for Microsoft® Windows (EPIWIN V3.05, U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics, Washington, D.C.)
Klimisch = 2

Ref. (14). PD-1: Photodegradation
Estimation Programs Interface for Microsoft® Windows (EPIWIN V3.05, U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics, Washington, D.C.)
Klimisch = 2

Ref. (15) TD-1: Transport/Distribution
Estimation Programs Interface for Microsoft® Windows (EPIWIN V3.05, U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics, Washington, D.C.)
Klimisch = 2